Hybrid and Electric Vehicle Design

Saber Simulator is a Complete Design and Verification Solution

Design Challenges

Consumer demand for higher fuel efficiency and decreased vehicle emissions has accelerated the development of pure electric (EV) and hybrid electric (HEV) drivetrains. Most automobile manufacturers have already released their plans for HEV / EV segments that would replace the existing diesel / gasoline drivetrains. These vehicles depend on advanced electronically-controlled systems working together across a wide range of operating conditions to ensure efficient performance, safety and reliability. Increasing electrical content and complexity coupled with shorter design cycles require design teams to continually improve their design methods for mechatronic integration. To minimize risk and potential recall or re-design, engineers rely on simulation- based Robust Design methods to deliver predictable and reliable designs.

Saber for Hybrid and Electric Vehicles

- Evaluate design architecture tradeoffs (parallel, serial, or complex topologies)
- Analyze power generation and distribution for motor drives and controls, regenerative braking, power assist, etc. Incorporate multi-domain effects at the system level – mechanical, electrical, thermal, and magnetics
- Design, test, and verify control strategies, power management, torque/speed coupling, and vehicle dynamics
- Optimize cost, performance, and reliability with advanced stress, sensitivity, and statistical analyses
- Specify and size HEV and EV powertrains and components (motors, controllers, and energy management)
- Analyze complex power electronics systems for signal integrity and electromagnetic compatibility (EMC)
- Verify hardware/software interactions using real controller target code
- Use characterized semiconductor models from the built-in library and modeling tools (IGBTs, MOSFETs, diodes, etc.)
- Accurately model Battery for cell-level and pack-level behavior using SaberRD's new Battery Tool
- Flexibility to import and use Motor models into Saber from established FEA motor modeling tools
- Use industry-standard languages (VHDL-AMS, MAST) for model exchange throughout the supply chain
- Enhance system safety and reliability using Robust Design methodologies, Worst Case Analysis, and Fault Analysis
- Increase analysis throughput with distributed grid computing

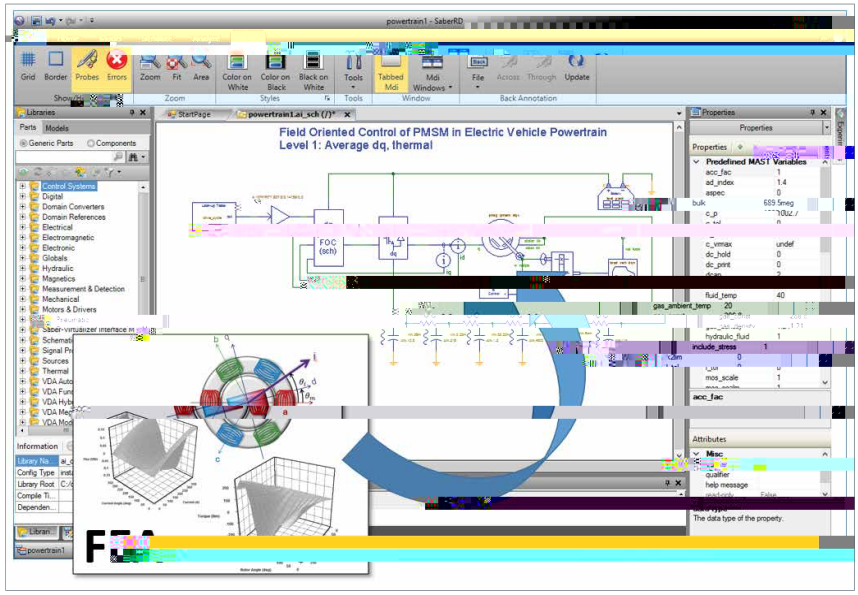

Figure 1: Hybrid Vehicle Powertrain design

Mechatronic Design and Verification of Hybrid and Electric Vehicles

Hybrid electric vehicles combine components from the traditional internal combustion engine powertrain with electronic drivetrain components such as an electric motor/generator, battery pack, and numerous controllers and sensors. Optimizing the power systems in HEVs increases fuel economy and reduces emissions, while still providing sufficient torque to the drivetrain to meet power demand.

Safe and reliable vehicle operation depends on the successful integration and verification of all drivetrain components. Integrating electrical, mechanical, and software disciplines together to create mechatronic systems becomes more challenging in hybrid and electric vehicles with the dramatic increase in switching and control systems. This increased complexity in mechatronic systems creates a greater challenge to produce reliable vehicles that meet stringent emissions, fuel economy, and performance criteria.

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